

## NATURAL RESOURCES CONSERVATION SERVICE

### CONSERVATION PRACTICE STANDARD

#### WATERING FACILITY

(no.)  
CODE 614

#### DEFINITION

A device (tank, trough, or other watertight container) for providing animal access to water.

#### PURPOSE

To provide watering facilities for livestock and/or wildlife at selected locations in order to:

- protect and enhance vegetative cover through proper distribution of grazing;
- provide erosion control through better grassland management; or
- protect streams, ponds and water supplies from contamination by providing alternative access to water.

#### CONDITIONS WHERE PRACTICE APPLIES

This practice applies where there is a need for new or improved watering facilities *to permit the desired level of grassland management, to reduce health hazards for livestock, and to reduce livestock waste in streams.*

#### Scope

*This standard applies to troughs or tanks, installed to provide livestock water, that are supplied by springs, ponds, wells, streams, or other sources.*

#### CRITERIA

##### General Criteria Applicable To All Purposes

A trough or tank shall have adequate capacity to meet the water requirements of the livestock and/or wildlife. This will include the storage volume necessary to carry over between periods of replenishment. *Livestock watering facilities shall have the capacity to meet the water requirements in Table I.*

Table I  
*Livestock Water Requirements<sup>1/</sup>*

<i>Gallons per Animal per</i>	
<i>Day</i>	
<i>Beef cattle and horses</i>	<i>12</i>
<i>Dairy cattle</i>	<i>25</i>
<i>Sheep and goats</i>	<i>1-1/2</i>

<sup>1/</sup> *For livestock water, the installation shall have a storage capacity in gallons not less than the table values per animal per day times the replenishment interval based on the predictable dry seasons or on the reliability of the water source.*

Where water supplies are dependable and livestock are checked daily, troughs with little water storage capacity may be used. *If the water troughs do not have sufficient volume, a water storage tank or other storage structure will be included in the livestock water system to provide the volume of storage required.* Troughs or

tanks must provide the daily water requirement of the livestock and provide access to the entire herd within a short period of time.

The site shall be well drained or, if the site is not well drained, drainage measures shall be provided. Areas adjacent to the trough or tank that will be trampled by livestock shall be graveled, paved, or otherwise treated to provide firm footing and reduce erosion. Design of the protective surface around the trough shall be in accordance with the standards for the practice **Heavy Use Area Protection** (Code 561).

Automatic water level control and/or overflow facilities shall be provided as appropriate. Valves or pipes shall be protected by shields or covers to prevent damage by livestock. Overflow shall be piped to a stable or suitable point of release.

*Roofs can be placed over the trough to provide shade and reduce loss of water by evaporation.* When a roof is placed over the trough to provide shade, the roof shall be designed for appropriate wind loads and shall be durable to withstand anticipated livestock and wildlife activities.

All materials shall have a life expectancy that meets or exceeds the planned useful life of the installation.

Common construction materials are reinforced concrete, steel, fiberglass, plastic and wood. All designs shall meet the industry standards for the material being used. Generally applicable design requirements and procedures can be found in the documents referenced at the end of this standard.

Concrete structures shall be constructed from a concrete mix producing a minimum compressive strength of 3,000 psi at 28 days.

*Minimum thickness for galvanized corrugated steel tanks and bolted flat steel plate tanks is shown in Tables III and IV. Table II shows the relationship of gauge number to thickness. Minimum wall thickness for welded flat steel plate tanks shall be approved by the State Conservation Engineer.*

*The exterior of steel tanks shall be galvanized or painted. Interior protective coating shall be provided on steel tanks where the pH of the water stored is 6.5 or lower. Steel water troughs and tanks requiring protective interior coatings shall be galvanized or painted with nontoxic paint.*

Plastic and fiberglass structures shall be made of ultraviolet resistant materials or shall have a durable coating to protect the structure from deterioration due to sunlight.

*Fiberglass water troughs and tanks shall be protected from sunlight by one of the following procedures:*

- 1. Covering the interior and exterior surfaces with a nontoxic-gel coat at least 20-mil thick of white or pastel shade in the manufacture of the trough or tank.*
- 2. Painting the interior and exterior surfaces black followed by a coat of white or other light-colored, nontoxic, waterproof paint; the black to block out ultraviolet rays and the light-colored paint to reflect heat.*
- 3. Locating the trough or tank under cover. For tanks with a top cover or under a catchment roof that shields the interior of the tank from sunlight, painting of the interior is not required.*

## **Water Systems**

### **Materials**

*Water troughs may be constructed of used materials if their durability approaches that of commonly used new materials. Prefabricated water troughs of steel or fiberglass may be used. Also, troughs can*

*be constructed out of reinforced concrete or concrete hollow-tile blocks. Standard plans are available for reinforced concrete and hollow-tile block troughs.*

## **Water Storage Tanks**

### **Materials**

*The following types of water storage tanks may be used:*

*reinforced concrete  
galvanized corrugated steel  
steel plate  
redwood  
galvanized corrugated steel with butyl rubber or vinyl liner and a gravel or concrete bottom  
fiberglass  
hollow-tile block*

### **Structural Requirements**

**Reinforced concrete.** Reinforced concrete walls shall be designed in accordance with ACI Code 318-77 or Section 6 of the National Engineering Handbook (NEH-6) and Engineering Design Standards, Far West States.

*Footings are needed for reinforced concrete walls. Footings shall be at least 12 inches thick and 18 inches wide. Construction joints between footings and reinforced concrete walls shall be allowed.*

*Nonstructural concrete slabs shall have a minimum thickness of 5 inches. Minimum reinforcement shall be 6 inch x 6 inch 10-gauge wire reinforcing mesh. Concrete placed on Aa or other coarse material shall be protected with a blanket of fine granular material or crushed to prevent excessive concrete loss in the large void areas.*

**Galvanized corrugated steel.** Corrugations for metal sheets shall be 2-2/3 inch x 1/2 inch.

*Table III tanks shall be connected with 3/8-inch diameter bolts as shown in Figures 1, 2, 3, and 4. Bolt hole diameters shall not exceed 1/2 inch.*

*Table IV tanks shall have 5/16-inch diameter bolt connections as shown in Figures 5 and 6. Bolt hole diameters shall not exceed 7/16 inch.*

*The distance from the edge of the corrugated metal sheets shown in Figures 1, 2, 3, 4, 5, and 6 is the minimum acceptable spacing.*

*Bolting pattern shall be the same for gauge material thicker than that shown in Table III or Table IV. An 18-gauge, 12-foot diameter, 12-foot high tank requires double bolts in the bottom 4 feet.*

*Tanks exceeding 12 feet in height, 36 feet in diameter, or having different corrugations shall be individually designed and the wall thickness determined using structural analysis.*

**Table II**  
**Conversion of Nominal Gauge to Thickness**

Gauge (no.)	Galvanized Thickness (in.)	Uncoated Thickness (in.)
12	0.109	0.1046
14	0.079	0.0747
16	0.064	0.0598
18	0.052	0.0478

*Table III*  
*2-2/3 inch x 1/2 inch Corrugated Steel*  
*Water Tanks with 3/8-inch Dia. Bolt*  
*Connections*

<i>Minimum Wall Thickness - Gauge</i>							
<i>Height</i>	<i>Diameter - Feet</i>						
<i>(ft.)</i>	<i>8</i>	<i>12</i>	<i>16</i>	<i>20</i>	<i>24</i>	<i>28</i>	<i>32</i>
<i>2</i>	<i>18</i>	<i>18</i>	<i>18</i>	<i>18</i>	<i>18</i>	<i>18</i>	<i>18</i>
<i>4</i>	<i>18</i>	<i>18</i>	<i>18</i>	<i>18</i>	<i>18</i>	<i>18<sup>1/</sup></i>	
<i>18<sup>1/</sup></i>							
<i>6</i>	<i>18</i>	<i>18</i>	<i>18</i>	<i>18<sup>1/</sup></i>	<i>18<sup>1/</sup></i>	<i>18<sup>1/</sup></i>	
<i>18<sup>1/</sup></i>							
<i>8</i>	<i>18</i>	<i>18</i>	<i>18<sup>1/</sup></i>	<i>18<sup>1/</sup></i>	<i>18<sup>1/</sup></i>	<i>16<sup>2/</sup></i>	
<i>16<sup>2/</sup></i>							
<i>10</i>	-	<i>18<sup>1/</sup></i>	<i>18<sup>1/</sup></i>	<i>16<sup>1/</sup></i>	<i>16<sup>2/</sup></i>	<i>14<sup>2/</sup></i>	
<i>14<sup>3/</sup></i>							
<i>12</i>	-	<i>18<sup>1/</sup></i>	<i>18<sup>1/</sup></i>	<i>16<sup>2/</sup></i>	<i>14<sup>2/</sup></i>	<i>12<sup>2/</sup></i>	
<i>12<sup>3/</sup></i>							

<sup>1/</sup> *Double row, Figure 2.*

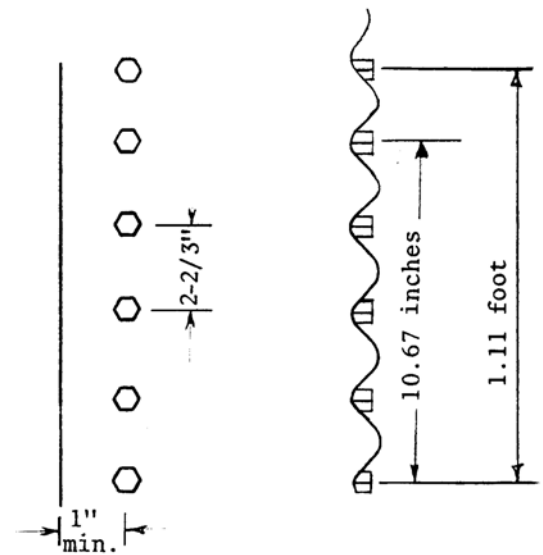
<sup>2/</sup> *Single-double row, Figure 3.*

<sup>3/</sup> *Double-double row, Figure 4.*

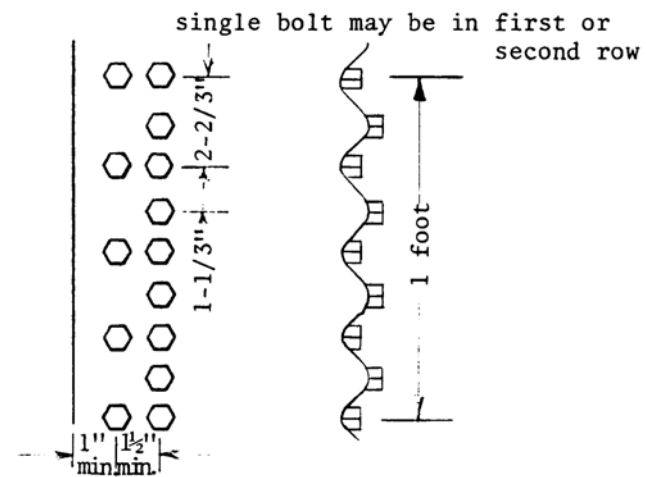
*Table IV*  
*2-2/3 inch x 1/2 inch Corrugated Steel*  
*Water Tanks with 5/16 inch Dia. Bolt*  
*Connections*

<i>Minimum Wall Thickness - Gauge</i>						
<i>Height</i>	<i>Diameter - Feet</i>					
<i>(ft.)</i>	<i>15</i>	<i>21</i>	<i>24</i>	<i>27</i>	<i>30</i>	<i>33</i>
<i>36</i>						
<i>3'-7"</i>	<i>18</i>	<i>18</i>	<i>18</i>	<i>18</i>	<i>18</i>	<i>18</i>
<i>18</i>						
<i>7'-1"</i>	<i>18</i>	<i>18<sup>1/</sup></i>	<i>18<sup>1/</sup></i>	<i>18<sup>1/</sup></i>	<i>18<sup>1/</sup></i>	<i>16<sup>1/</sup></i>
<i>16<sup>1/</sup></i>						
<i>10'-8"</i>	<i>18<sup>1/</sup></i>	<i>18<sup>1/</sup></i>	<i>16<sup>1/</sup></i>	<i>16<sup>1/</sup></i>	-	-

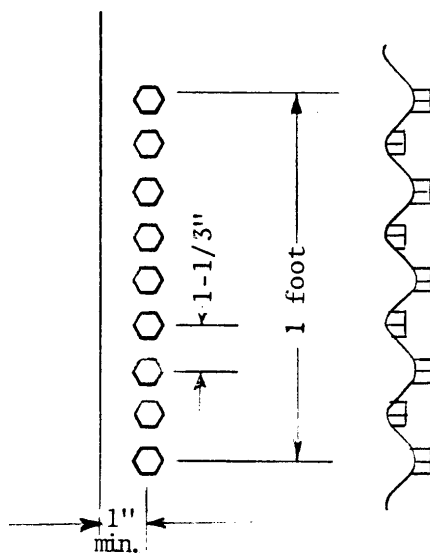
<sup>1/</sup> *Double bolted, Figure 6.*



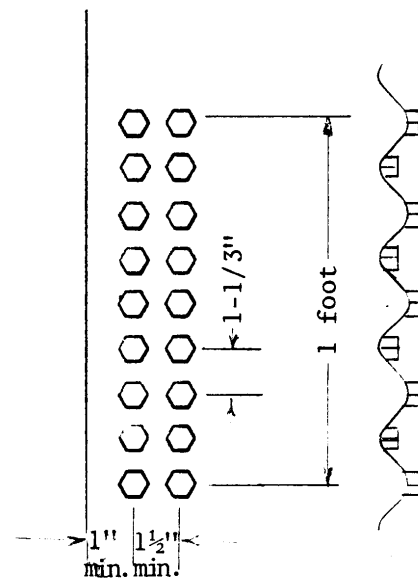
**FIGURE 1**  
**Single Row**  
(5 bolts per foot)  
Bolt in bottom of each corrugation.



**FIGURE 3**  
**Single-double Row**  
(14 bolts per foot)  
Bolt in top and bottom of each corrugation.



**FIGURE 5**  
**Single Row**  
(9 bolts per foot)  
Bolt in top and bottom  
of each corrugation.



**FIGURE 6**  
**Double Row**  
(18 bolts per foot)  
Bolt in top and bottom  
of each corrugation.

**Flat steel plate.** A ring stiffener shall be attached to the top of welded flat steel plate tanks.

**Redwood tanks.** All redwood tanks shall be manufactured from clear, all-heart redwood with a minimum 2-inch nominal thickness

(1-1/2-inch finished thickness). The tanks shall be reinforced around the circumference with painted, plastic coated, or galvanized 1/2-inch steel rods spaced as required to withstand static water pressure.

Redwood tanks shall have chime joists installed to transfer the load of the tank and contents from the floor to the foundation. The chime joists shall be large enough to provide a minimum of 1-inch clearance below the staves to allow for free circulation of air. The weight of a redwood tank will not be borne by the staves.

Concrete slabs, concrete piers, and walls or other approved materials, such as prefabricated support supplied by the manufacturer, shall be used as a foundation for redwood tanks.

The piers or pier wall shall have a sufficient bearing area on the ground so that the following foundation loading will not be exceeded:

Soil Material	Foundation Loading (lbs./sq. ft.)
Dense pahoehoe	20,000
Fractured pahoehoe	12,000
Aa lava flows	10,000
Granular soils (cinders, sand, etc.)	4,000
Cohesive soils (clays and silty clays)	2,500
Valley alluvium	1,000

Corrugated metal tanks with liners. The wall thickness requirements for corrugated metal tanks with liners are the same as shown in Table III and Table IV.

Tank liners can be either butyl rubber or vinyl but they must meet the material requirements of the practice **Pond Sealing or Lining - Flexible Membrane** (Code 521-A). Tanks with plastic liners shall have a cover or roof.

Rock foundation pad or other foundation material is needed for tanks with no metal base. These foundation pads shall be constructed using 1-inch maximum diameter crushed rock or cinders. The minimum thickness of the foundation pad shall be 4 inches. Also, a 9-inch minimum height fillet of the base material shall be placed around the inside of the walls before the lining is installed. A sand or fine soil cushion shall be used between the liner and the foundation pad.

Other foundation materials such as concrete slabs may be used. In all cases, the 9-inch high fillet shall be placed around the inside walls before the lining is installed.

Fiberglass tanks. Minimum wall thickness for fiberglass tanks is shown in Table V. Tanks of this material exceeding 10 feet in height or 12 feet in diameter shall be individually designed and the wall thickness determined by structural analysis.

Table V  
Fiberglass Tanks  
Minimum Wall and Bottom Thickness -  
Inches

Height (ft.)	Diameter - Feet						
	6	7	8	9	10	11	12
4	3/16	3/16	3/16	3/16	3/16	3/16	3/16
6	3/16	3/16	3/16	3/16	1/4	1/4	1/4
8	3/16	1/4	1/4	1/4	1/4	1/4	5/16
10	1/4	1/4	1/4	1/4	5/16	5/16	5/16

Fiberglass tank material shall meet the requirements of National Bureau of Standards Voluntary Product Code PS-15-69.

Rock foundation pad or other foundation material may be used as a base for the tank. These foundation pads shall be constructed using 1-inch maximum diameter crushed rock or cinders. The minimum thickness of the foundation pad shall be 4 inches. Other materials such as concrete slabs may be used.

Concrete hollow-tile block. Tanks with concrete hollow-tile block walls shall be designed in accordance with ACI Code 531.

Hollow-tile block tanks shall be sealed on the inside with an appropriate material.

### **Anchorage**

The weight of an empty tank shall be sufficient to resist overturning by wind movement. The weight of an empty tank shall be sufficient to resist overturning from wind pressures or the design shall include secure anchorage or a raised drain outlet that retains sufficient weight of water for stability.

Table VI  
Corrugated Steel Tanks  
Minimum Water Level in Tank - Inches

Height (ft.)	8	12	15	16	20	21
4	2	*	*	*	*	*
6	2	*	*	*	*	*
7'-1"	*	2	2	*	*	*
8	4	2	*	2	*	*
10	*	4	*	2	*	*
10'-8"	*	*	2	*	*	2
12	*	4	*	2	2	*

\*Does not correspond to Table III or Table IV.

Table VII  
Fiberglass Tanks  
Minimum Water Level in Tank - Inches

Height (ft.)	6	7	8	9	10	11	12
4	2	2	2	2	2	2	2
6	4	4	2	2	2	2	2

Wind loadings shall be calculated based on a minimum pressure of 30 pounds per square foot on the largest side of rectangular tanks and 18 pounds per square foot on projected areas of the cylindrical surfaces of round tanks.

The weight of empty steel tanks can be calculated using the information on Table VIII.

Minimum water level for cylindrical corrugated steel tanks is shown in Table VI. Minimum water levels for cylindrical fiberglass tanks are shown in Table VII.

8	6	4	4	4	2	2	2
10	10	8	6	4	4	2	2

Table VIII  
Weights in Pounds/Sq. Ft. for Sheet Metal

Uncoated Black Sheet Steel	
Gage	lbs/ft <sup>2</sup>
000 (3/8")	15.00
7 (3/16")	7.65
10	5.63
12	4.38
14	3.13

Table VIII (contd.)  
Weights in Pounds/Sq. Ft. for Sheet Metal

Galvanized Flat Steel	
Gage	lbs/ft <sup>2</sup>
8 (3/16")**	7.03
10	5.78
12	4.53
14	3.28
16	2.66



*Galvanized Corrugated Steel*

<i>Gage</i>	<i>Dimension of Corrugation</i>	<i>lbs/ft<sup>2</sup></i>
10	2-1/2x 1/2*	6.31
12	2-1/2x 1/2	4.94
14	2-1/2x 1/2	3.58
16	2-1/2x 1/2	2.90
18	2-1/2x 1/2	2.35
10	2-2/3x 1/2*	6.31
12	2-2/3x 1/2	4.94
14	2-2/3x 1/2	3.58
16	2-2/3x 1/2	2.90
18	2-2/3x 1/2	2.35
12	3x3/4	5.23
14	3x3/4	3.79
16	3x3/4	3.07
18	3x3/4	2.49

\* Actually, standard 2-1/2 corrugated sheets have 9 corrugations exclusive of side lap and cover a width of 24 inches; therefore, the corrugation pitch measures approximately 2-2/3 inches.

\*\* Thickness equivalent for 8-gage galvanized sheet is 0.1681. Weights for 3/16 inch galvanized sheet are not listed in common tables. Use 8-gage where tables call for 3/16 inch.

## CONSIDERATIONS

This practice may adversely affect cultural resources and must comply with GM 420, Part 401.

Topography should be evaluated to minimize trail erosion and flooding erosion from tank overflow.

Watering facilities should be accessible to small animals. Escape ramps for birds and small animals should be installed.

Adequate protection for livestock during the winter should be considered.

## PLANS AND SPECIFICATIONS

Plans and specifications for installing troughs and tanks shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. If the trough and/or tank is a component of a system that includes additional conservation practices, the information necessary to construct these additional practices will also be conveyed on the plans.

Development of plans will be guided by Engineering Field Handbook (EFH), Part 650, Chapter 5, and shall be in accordance with National Engineering Manual, Parts 541 and 542.

*Plans for application of livestock water troughs shall show the location, capacity and materials for each trough. Standard construction plans are available showing the construction details for reinforced concrete and concrete hollow-tile block water troughs.*

*Construction plans for water storage tanks shall show the location, capacity, dimensions, material requirements, and foundation requirements. For tanks that are not prefabricated, plan drawings shall be prepared that are sufficient for construction.*

## OPERATION AND MAINTENANCE

An O&M plan specific to the type of installed trough or tank shall be provided to the landowner. The plan shall include, but not be limited to, the following provisions:

- check for debris, algae, sludge or other materials in the trough which may restrict the inflow or outflow system;
- check for leaks and repair immediately if any leaks are found;
- check the automatic water level device to insure proper operation;
- check to ensure that adjacent areas are well protected against erosion;

- check to ensure the outlet pipe is freely operating and not causing erosion problems; and
- prepare guidance for winter weather, such as adding material in the storage area to allow for ice expansion without damage.

Algae and iron sludge accumulation should be addressed in areas with water quality that is known to cause problems.

Chemicals such as copper sulfate and chlorine can be recommended as needed, as long as local rules and regulations are followed.

## REFERENCES

Engineering Field Handbook

National Engineering Manual

Manual of Steel Construction, American Institute of Steel Construction

Timber, National Design Specification for Wood, American Forest and Paper Association

Concrete, ACI 318, American Concrete Institute

Masonry, Building Code Requirement for Masonry Structures, ACI 530, American Concrete Institute